REMARKS

Applicant thanks Examiner Markham for the interview. Applicant respectfully requests reconsideration of the rejection in the instant application. Upon entry of the above amendment, claims 1, 3, and 5-28 remain pending in the present application. Claims 1, 5, 8, 13, and 15 have been amended, while new claims 19-28 have been added. Applicant believes no new matter has been added due to the amended or newly added claims.

Rejection of Claims 1, 3, 5-18

Claims 1, 3, 5-7 and 9-18 have been rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,626,922 to Miyanaga *et al.* ("Miyanaga") in view of U.S. Patent No. 5,945,162 to Senateur *et al.* ("Senateur") and in view of U.S. Patent No. 5,236,545 to Pryor *et al.* ("Pryor"). Claim 8 has been rejected under 35 U.S.C. §103(a) as being unpatentable over Miyanaga in view of Senateur, Pryor, and U.S. Patent No. 5,381,755 to Glesener *et al.* ("Glesener"). Applicant respectfully urges that the rejections have been overcome by the amendment of claims 1, 5, 8, 13, and 15 herein.

Claim Objections

Claims 13 and 15 have been amended to overcome the claim objections indicated by the Examiner. Therefore, the claim objections should be withdrawn.

Claim 1

Claim 1 presently stands rejected under 35 U.S.C. §103 as allegedly being unpatentable over Miyanaga in view of Senateur and Pryor. Claim 1, as amended, reads as follows:

> 1. A method of forming diamond crystals or a diamond film comprising disposing a substrate in a reaction chamber;
> introducing, in the absence of a gas stream, a liquid precursor substantially free of water and methanol and at least one carbon and oxygen containing compound having a carbon to oxygen ratio greater than one into an inlet of the reaction chamber;
> vaporizing the liquid precursor; and
> ***subjecting the vaporized precursor, in the absence of a carrier gas, to a plasma*** under conditions effective to disassociate the vaporized precursor and promote diamond growth on the substrate.

(Emphasis added). Applicant submits that the rejection of claim 1 under 35 U.S.C. §103 should be withdrawn because Miyanaga in view of Senateur and Pryor, individually or in combination, does not disclose, teach, or suggest "subjecting the vaporized precursor, in the absence of a carrier gas, to a plasma" as highlighted in amended claim 1 above. Miyanaga teaches the use of a carrier gas (hydrogen) and select hydrocarbons in a plasma to produce diamond film (Col. 5, lines 26-32). Miyanaga states that hydrogen does not participate in the reaction. However, Miyanaga defines a gas which does not "participate" as a "a gas which does not produce a solid upon decomposition reaction" (Col. 5, lines 27-28). Although hydrogen does not contribute to the deposition of carbon, hydrogen does contribute to Miyanaga's process by reacting with the hydrocarbon gas, which is well known to those skilled in the art. For example, the significance of hydrogen to the deposition of diamond materials is discussed in Pryor (Col. 7, lines 47-64). In addition, the significance of hydrogen is illustrated by the significant hydrogen gas flow used in Miyanaga (Col. 5, lines 26-31). Thus, Miyanaga does not disclose, teach, or suggest, at least the limitation highlighted above in amended claim 1. Miyanaga instead teaches

away from the invention claimed in claim 1 because hydrogen is a necessary component of Miyanaga's process.

By eliminating the prior-expected need for a carrier gas (such as hydrogen in Miyanaga), Applicant's claimed invention has produced unexpected results. Prior processes that relied on hydrogen necessitated processing parameters in a narrow range because the processing parameters were dependent upon hydrogen chemistry, which is well known by those skilled in the art and as discussed in Pryor. Additionally, the process of the presently claimed invention is also safer, more economical, and produces a higher quality diamond than the cited prior art. In particular, the equipment required to handle compressed gases are more expensive (*i.e.*, gas manifolds and mass flow controllers). In addition, the use of hydrogen can be unsafe, since hydrogen is explosive. Further, by eliminating the need for hydrogen, a higher carbon-to-hydrogen ration can be achieved in the plasma using the claimed invention, which produces a greater deposition rate relative than the cited prior art. Thus, for at least the reasons stated above, the invention as claimed in claim 1 shows unexpected results over the cited prior art.

It should also be noted that Senateur teaches the use of a carrier gas (Col. 3, lines 63-67; Col. 4, lines 32-43; Col. 5, lines 41-42; Col. 6, lines 29-31; and Examples 1-5). Likewise, Pryor also teaches the use of a carrier gas (Fig. 1 and Col. 7, lines 47-64). Thus, Miyanaga, Senateur, and Pryor not disclose, teach, or suggest, at least the limitation highlighted above in amended claim 1, and in fact teach against the present invention as claimed in claim 1. Therefore, the rejection to claim 1 should be withdrawn.

Claims 3 and 5-12

Applicant respectfully submits that pending dependent claims 3, 5-7, and 9-12 include every feature of independent claim 1 and that Miyanaga in view of Senateur and Pryor,

individually or in combination, fail to disclose, teach, or suggest at least the features of claim 1 highlighted hereinabove. In addition, Applicant respectfully submits that pending claim 8 includes every feature of independent claim 1 and that Miyanaga, in view of Senateur, Pryor, and Glesener, individually or in combination, fail to disclose, teach, or suggest at least the feature of claim 1 highlighted hereinabove. Thus, pending dependent claims 3 and 5-12 are allowable over the prior art of record. *In re Fine*, 5 U.S.P.Q.2d 1596, 1600 (Fed. Cir. 1988).

Claim 13

Claim 13 presently stands rejected under 35 U.S.C. §103 as allegedly being unpatentable over Iida in view of Senateur. Claim 13, as amended, reads as follows:

> 13. A plasma enhanced chemical vapor deposition of diamond crystals and diamond films on surfaces of a substrate, comprising:
>
> providing an apparatus including an inlet, a disassociation zone, a deposition zone and an outlet;
>
> introducing, in the absence of a gas stream, a liquid precursor substantially free of water and comprising methanol and at least one carbon and oxygen containing compound having a carbon to oxygen ratio greater than one, into the inlet under conditions effective to vaporize the liquid precursor, flow the vaporized precursor through the disassociation zone, and through the outlet;
>
> disassociating and reacting the vaporized precursor as vaporized precursor flows or diffuses through the disassociation zone to produce OH, H, O, and carbon containing radicals; and
>
> ***producing diamond crystals or diamond films on the surface of the substrate in the absence of a carrier gas.***

(Emphasis added.) Applicant submits that the rejection of claim 13 under 35 U.S.C. §103 should be withdrawn because Miyanaga in view of Senateur and Pryor, individually or in combination, does not disclose, teach, or suggest "producing diamond crystals or diamond films on the surface of the substrate in the absence of a carrier gas" as highlighted in amended claim 13 above. Miyanaga teaches the use of a carrier gas (hydrogen) and select hydrocarbons in a plasma to produce diamond film (Col. 5, lines 26-32). Miyanaga states that hydrogen does not

participate in the reaction. However, Miyanaga defines a gas which does not "participate" as a "a gas which does not produce a solid upon decomposition reaction" (Col. 5, lines 27-28). Although hydrogen does not contribute to the deposition of carbon, hydrogen does contribute to Miyanaga's process by reacting with the hydrocarbon gas, which is well known to those skilled in the art. For example, the significance of hydrogen to the deposition of diamond materials is discussed in Pryor (Col. 7, lines 47-64). In addition, the significance of hydrogen is illustrated by the significant hydrogen gas flow used in Miyanaga (Col. 5, lines 26-31). Thus, Miyanaga does not disclose, teach, or suggest, at least the limitation highlighted above in amended claim 1. Miyanaga instead teaches away from the invention claimed in claim 1 because hydrogen is a necessary component of Miyanaga's process.

By eliminating the prior-expected need for a carrier gas (such as hydrogen in Miyanaga), Applicant's claimed invention has produced unexpected results. Prior processes that relied on hydrogen necessitated processing parameters in a narrow range because the processing parameters were dependent upon hydrogen chemistry, which is well known by those skilled in the art and as discussed in Pryor. Additionally, the process of the presently claimed invention is also safer, more economical, and produces a higher quality diamond than the cited prior art. In particular, the equipment required to handle compressed gases are more expensive (*i.e.*, gas manifolds and mass flow controllers). In addition, the use of hydrogen can be unsafe, since hydrogen is explosive. Further, by eliminating the need for hydrogen, a higher carbon-to-hydrogen ration can be achieved in the plasma using the claimed invention, which produces a greater deposition rate relative than the cited prior art. Thus, for at least the reasons stated above, the invention as claimed in claim 1 shows unexpected results over the cited prior art.

It should also be noted that Senateur teaches the use of a carrier gas (Col. 3, lines 63-67; Col. 4, lines 32-43; Col. 5, lines 41-42; Col. 6, lines 29-31; and Examples 1-5). Likewise, Pryor

teaches the use of a carrier gas (Fig. 1 and Col. 7, lines 47-64). Thus, Miyanaga, Senateur, and Pryor not disclose, teach, or suggest, at least the limitation highlighted above in amended claim 1, and in fact teach against the present invention as claimed in claim 1. Therefore, the rejection to claim 1 should be withdrawn.

Claims 14-18

Applicant respectfully submits that pending dependent claims 14-18 include every feature of independent claim 13 and that Miyanaga in view of Senateur and Pryor, individually or in combination fail to disclose, teach, or suggest at least the features of claim 13 highlighted hereinabove. Thus, pending dependent claims 14-18 are allowable over the prior art of record. *In re Fine*, 5 U.S.P.Q.2d 1596, 1600 (Fed. Cir. 1988).

Claims 20, 21, and 25

Newly added claims 20, 21, and 25 are patentable over the prior art cited because the prior art does not disclose, teach, or suggest at least the highlighted features below.

20. A method of forming diamond crystals or a diamond film comprising:
disposing a substrate in a reaction chamber;
introducing a liquid precursor containing methanol and at least one carbon and oxygen containing compound having a carbon to oxygen ratio greater than one into an inlet of the reaction chamber;
vaporizing the liquid precursor;
subjecting the vaporized precursor to a plasma under conditions effective to disassociate the vaporized precursor; and
promoting diamond growth on the substrate at a rate between about 1 micrometer and 2.7 micrometers per hour.

21. A method of forming diamond crystals or a diamond film comprising:
disposing a substrate in a reaction chamber;
introducing a liquid precursor containing methanol and at least one carbon and oxygen containing compound having a carbon to oxygen ratio greater than one into an inlet of the reaction chamber;
vaporizing the liquid precursor;
subjecting the vaporized precursor to a plasma under conditions effective to disassociate the vaporized precursor; and
promoting diamond growth on the substrate, in the absence of a carrier gas.

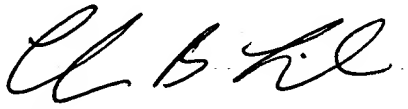
25. A plasma enhanced chemical vapor deposition of diamond crystals and diamond films on surfaces of a substrate, comprising:
providing an apparatus including an inlet, a disassociation zone, a deposition zone and an outlet;
introducing a liquid precursor comprising methanol and at least one carbon and oxygen containing compound having a carbon to oxygen ratio greater than one, into the inlet under conditions effective to vaporize the liquid precursor, flow the vaporized precursor through the disassociation zone, and through the outlet;
disassociating and reacting the vaporized precursor as vaporized precursor flows or diffuses through the disassociation zone to produce OH, H, O, and carbon containing radicals; and
producing diamond crystals or diamond films on the surface of the substrate in the absence of a carrier gas.

(Emphasis added). The cited references do not disclose, teach, or suggest "promoting diamond growth on the substrate at a rate between about 1 micrometer and 2.7 micrometers per hour", as claimed in claim 20. In addition, the cited references do not disclose, teach, or suggest the highlighted portions of claim 21 and 25 for reasons similar to that of claims 1 and 13 discussed above. Therefore, claims 20, 21, and 25 and dependent claims 22-24 (dependent upon claim 22) are in condition for allowance.

CONCLUSION

Upon entry of the above amendments, claims 1, 3, and 5-28 remain pending in the present application. It is respectfully submitted that claims 1, 3, and 5-28 of the present application are in a condition for allowance and an early notice to such effect is earnestly solicited. If the Examiner believes that unresolved issues remain, it is requested that the Examiner contact the undersigned counsel for Applicant by telephone in order to expedite resolution and disposal.

Respectfully submitted,



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ANNOTATED VERSION OF MODIFIED CLAIMS TO SHOW CHANGES MADE

The following is a marked up version of the amended claims. Amend the following claims by adding the language that is underlined ("___") and by deleting the language that is enclosed within brackets ("[ ]"):

1. (Thrice Amended) A method of forming diamond crystals or a diamond film comprising disposing a substrate in a reaction chamber;

introducing, in the absence of a gas stream, a liquid precursor substantially free of water and methanol and at least one carbon and oxygen containing compound having a carbon to oxygen ratio greater than one into an inlet of the reaction chamber;

vaporizing the liquid precursor; and

subjecting the vaporized precursor, in the absence of a carrier gas, to a plasma under conditions effective to disassociate the vaporized precursor and promote diamond growth on the substrate.

5. (Twice Amended) The method according to claim 1, wherein the carbon and oxygen containing compound is selected from ethanol, isopropanol, acetone, and combinations thereof.

8. (Twice Amended) The method according to claim 1, wherein the carbon and oxygen containing compound includes a dopant element or moiety.

13. (Thrice Amended) A plasma enhanced chemical vapor deposition of diamond crystals and diamond films on surfaces of a substrate, comprising:

providing an apparatus including an inlet, a disassociation zone, a deposition zone and an outlet;

introducing, in the absence of a gas stream, a liquid precursor substantially free of water and comprising methanol and at least one carbon and oxygen containing compound having a carbon to oxygen ratio greater than one, into the inlet under conditions effective

to vaporize the liquid precursor, flow the vaporized precursor through the disassociation zone, and through the outlet;

disassociating and reacting the vaporized precursor as vaporized precursor flows or diffuses through the disassociation zone to produce OH, H, O, and carbon containing radicals; and

[transporting the carbon_containing radicals to the substrate in the deposition zone to] produc[e]ing [the] diamond crystals or diamond films on the surface of the substrate in the absence of a carrier gas.

15. (Once amended) The process according to claim 13, wherein the introducing step comprises:

introducing the liquid precursor with methanol in an amount between about 0.5 wt. % and 99.5 wt. %.